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Founded in 1951 as the Los Angeles Chapter of the Federation of American Scientists, the Southern California Federation of Scientists is a non-profit educational organization dedicated to issues affecting SCIENCE, SOCIETY and PUBLIC POLICY. The **FORUM** is intended as a communications vehicle among our members and readers. We hope that our readers will send their comments and debate one another on the issues of the day. Please contact or send all materials to:

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THE FLAT TAX: ROBINHOOD in REVERSE

John Bachar and Paul O'Lague

What is the flat tax?

The short, non-technical answer is that it is a scheme (of which there are many variations) advocated by some very well-off persons (such as Forbes, Kemp, Gramm, Armev and Jerry Brown) which would transfer mega-billions of dollars from the overwhelming majority of taxpayers to the very wealthy. Creators of these schemes use slick snake-oil techniques in order to convince the overwhelming majority of taxpayers, whom they cynically regard as gullible, that the flat tax is a panacea for society's ills.

The technical answer now follows.

The present individual income tax system is a progressive rate system. It has been used for many years in the USA as well as in many countries. It is based on a tax *rate* on income that increases with increasing income. The reason for this system is *fairness*: for low incomes, all or most of it is used for the most basic human needs - food, shelter, clothing, transportation, education, utilities, and the like, and so the tax rate clearly should be zero (or nearly so) on such incomes. However, in the case of high incomes, much of it is surplus income, often well-above that needed for the basic human needs, and so the tax rate imposed on such surplus income should be increasing with the increasing size of such surplus income in order that the total income tax collected is sufficient to fund the needs of society - education, health, infrastructure, etc. Note that these benefits apply to all - both rich and poor. It is

fundamentally a part of our economic system (capitalism) that *most* of the income is held by a *very small percentage at the top end of the income spectrum* (for example, the \$72K and up income class [8.55% of all tax returns] holds 36% of all income), and consequently a higher tax rate must be levied at the top end, lest there be woefully inadequate tax revenues available to fund the vital needs of the society at large. *“You can’t get blood out of a turnip”!*

Various flat tax schemes first modify the *gross income* to something called the *taxable income*, after which a fixed rate is applied.

Two flat tax schemes will now be presented in summary form. All numerical results are derived from the complete IRS tabulations of all data contained in the 1993 collection of all 115 million tax returns filed that year (latest complete data available). The total adjusted gross income (AGI) was \$3.7 trillion, the total income tax (T) was \$500 billion. This implies an overall effective tax rate in 1993 of 13.46% (=T/AGI).

Scheme 1

1. No deduction and no exemption allowances are applied to AGI reported on every tax return. Thus, for example, home mortgage interest, medical expenses, charitable contributions, to name a few, are not allowed as deductions.

2. AGI reported on every tax return is taxed at 13.46%.

Some consequences:

i) Total income tax collected remains at \$500 billion (revenue “neutral”, i.e., same as present progressive rate system).

ii) Under the current progressive rate system, returns with an AGI of \$72K or *less* (91.45% of all returns) now pay *less* than 13.46% tax rate on the reported AGI, and returns with *more* than \$72K (8.55% of all returns) pay *more* than a 13.46% tax rate..

iii) Collectively, under scheme 1, the bottom 91.45% (\$72K or less) would pay **\$98 billion more**, while the top 8.55% (more than \$72K) would pay **\$98 billion less!**

iv) Under scheme 1, the average annual tax change for returns in the \$100K - \$200K AGI class would be \$6,619 *less*, for the \$200K - \$500K class,

\$35,615 *less*, for the \$500K - \$1M class, \$112,417 *less*, and for the \$1M and up class, \$451,135 *less!*

Scheme 2

1. Only the salary and wage income on a return is taxed. Thus, *unearned* income - dividends, interest, capital gains, etc. - is *not* taxed.

2. The proposed tax rate would be 17%.

Some consequences:

i) Every one in the \$0 - \$75K class (92.75% of all returns) would experience an *increase* in the percentage of AGI that yields the tax liability under scheme 2; collectively, the tax *increase* would be **\$117.5 billion**; for the \$75K and up class (7.25% of all returns), the percentage will *decrease greatly*; collectively, the tax *decrease* would be **\$126.9 billion!**

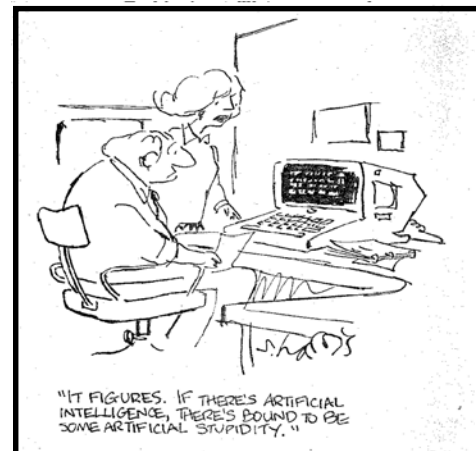
ii) There would be a total tax *decrease* of **\$9.4 billion** which would be *added* to the deficit.

iii) The tax *decrease* for the average return in each of the following classes would be: \$8,332 for the \$100K - \$200K class; \$44,739 for the \$200K - \$500K class; \$143,164 for the \$500K - \$1M class; \$639,318 for the \$1M and up class!

Perhaps we have caught your interest and wetted your appetite for the complete analysis of these two schemes, plus others, including the Forbes scheme (which would add about \$200 billion annually to the deficit), which is to appear in a forthcoming paper.

Try not to lose any sleep over any of these matters. A complete paper is planned for all SCFS members.

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EXPERIMENTAL BREEDER REACTOR IN IDAHO

James C. Warf

Summary of a more complete account to be sent to SCFS members.

The Department of Energy operated an experimental breeder reactor for 30 years in southeast Idaho, and considerable spent fuel has accumulated. The Laboratory has developed a process for treating this waste to separate out pure uranium with a high uranium-235 content and to convert everything else into a glass for geological disposal. Public hearings on a proposed environmental assessment were to be held. The Committee to Bridge the Gap was invited to send delegates for the hearings on February 21. The Southern California Federation of Scientists has long cooperated with the CBG. Four of us, Dan Hirsch (President of the CBG), Christine Owen and Bennett Ramberg (of the CBG and SCFS board), in addition to myself, attended.

More than 100 people were present at the hearings. The chair gave a lecture on the proposed technology and a panel of five DOE officials answered questions. The speakers presented the spectra of rationality and relevance. Dan gave a focused critique, outlining criticisms of the pyroprocessing procedures. Bennett and Christine developed the objection that once perfected, the process would enable smaller countries to use it to separate bomb-grade plutonium. I presented an alternative technology which avoids all separations.

Experimental Breeder Reactor II (EBR II) started up in 1965, producing about 300 kilowatts of electricity. The fuel consists of narrow uranium rods. It is 67% uranium-235 when fresh and approximately 65% on removal; the difference becomes fission products. Each fuel rod is inserted into a stainless steel tube and a small amount of sodium metal is also put in. The purpose of the sodium is to function as a heat-transfer agent. There is no moderator; the reactor operates on fast neutrons.

Outside the core is a large amount of depleted uranium (the blanket). Its purpose is to stop

or reflect the fast neutrons streaming out of the core. The uranium-238 blanket undergoes fission in part and absorbs the excess neutrons to form plutonium-239, that is, the process is breeding. EBR II is cooled by liquid sodium, no less than 66,000 gallons of it. In an experiment the reactor was going full blast and the sodium pumps were deliberately stopped. The reactor had a negative temperature coefficient of reactivity, and soon shut itself off.

An electrolytic technique has been developed at Argonne West to remove the unchanged uranium from the spent fuel and blanket and to collect the fission products and transuranic elements into a mineral which is then vitrified. Operators outside an argon-filled chamber look through five-foot lead-glass windows and manipulate the apparatus inside. The reactor itself is not visible since it is submerged in the tank of liquid sodium. EBR II is capable of using as fuel uranium-238 alloyed with plutonium from dismantled nuclear bombs and thus can contribute to the permanent destruction of this dreadful metal.

While not immune to possible dangers, the EBR II struck me as a distinct advance in reactor technology in some ways. The risk of a Chernobyl-like disaster is minuscule. Probably the greatest hazard, aside from creating more nuclear waste, arises from spreading sophisticated technologies around the world, technologies which make reprocessing spent fuel easier and possible in facilities small enough to conceal underground.

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SCFS Task Group Reports...

Shel Plotkin

INFOMED Project Report

SCFS only collected about thirteen or fourteen computers plus several printers and modems. The entire complement of computers was about 375. For unknown reasons this particular project frightened the U.S. government to the extent that all computers were seized by U.S. authorities at the Mexican border. Contrary to the L.A. Times coverage of the event, the confrontation between Pastors for Peace representatives and U.S. Immigration Border Guards resulted in considerable physical abuse to our people, all totally unnecessary, of course.

Participants report that the border guards showed up dressed in full riot gear. In this author's experience such dress attire at politically-oriented activities has always indicated the "cops" predisposition to riot. Unfortunately, that turned out to be the case on this occasion as well.

Finally, a subpoena was served on Pastors for Peace to provide testimony in New Jersey regarding shipments to Cuba in past years. One can interpret these machinations by our U.S. government in various ways, so readers are left to provide their own rationale.

At present, the New Jersey hearings have not taken place yet. And all computers, including a number from Canada, are still in government storage. SCFS members will be kept informed about these events.

For example, another Pastors for Peace caravan was attempted on February 17. This time the medicines and foodstuffs were allowed across the border, but again the computers were seized. Fortunately, there were only a small number. One interesting aspect was that a few people who previously fled Cuba are adamantly opposed to the U.S. blockade. They see their relatives still in Cuba suffering because of the illegal U.S. government actions—illegal by recognized and accepted international law. Apparently only the action of American citizens can stop the arrogance and arbitrary behavior of our government leaders.

"Disposal of High - Level Nuclear Waste"

It was announced that the Nuclear Age Peace Foundation in Santa Barbara was in the process of publishing our latest SCFS paper. Unfortunately, that publication has been held up as the two organizations have tried to accommodate each other's slightly diverse objectives. Fortunately there has now been a meeting of the minds.

Extra copies of the original paper are still available from the office now, and the NAPF paper should be available. Just call or write the office for copies.

Israeli - MWD Desalination Project

A joint Israeli - Metropolitan Water District desalination development project is now underway at Southern California Edison's Huntington Beach generating plant. The original concept, a form of the evaporation-type, came from the Water Research Institute at the Israel Institute of Technology, usually known as The Technion. Initial implementation funding was raised by the Southern California Chapter of the Technion. SCFS's own Sandy Elster has been a prime supporter of this project. At present a small test model has been built and is being tested; it generates 2000 gallons of fresh water per day from sea water and thus far has proven the technique to be viable.

MWD is now in the process of trying to fund a pilot plant which would generate 5 million gallons per day from a 150 high foot tower and cost about \$40M. Those familiar with desalination techniques will recognize the key feature of the Technion system, the very high tower. Normally an evaporation process is laid out horizontally, one Saudi Arabian plant being 1.5 miles in length which consists of many units. Not only is the Technion process vertical in nature but it reuses the initial heat for evaporation 30 times over. Final future goals for this process according to the MWD engineers is to produce water at about 2 times the normal cost, i.e. \$800 per acre-foot as compared with \$400 per acre-foot normal water cost -- DWP charges \$492 per acre-foot.

Final units will also use 150 foot high towers but will generate 75 million gallons of fresh water per day. Present horizontal Saudi units generate 70 million gallons per day per each. Hopefully MWD will be successful raising the funding required, and we will see a working production prototype in the near future.

**The Human Agenda: How to be at Home in the Universe - Without Magic* by Roderick Gorney
(a SCFS member)**

This free book is available from either The Humanist Society or Athiests United for only \$4.00 to cover postage and handling. Contact either of the following:

Warren Felt **OR** Ken Bonnell
16809 Marilla Street P.O. Box 65706
Northridge, CA 91343 Los Angeles, CA 90065

*Published in 1979 (3rd edition), a Book-of-the-Month Club selection in 1972 and used for courses at UCLA for a number of years. This text is an excellent addition to everyone's library.

California Political Reform Initiative

This initiative, an official SCFS project, will be on the ballot next Fall. While SCFS does not usually enter into normal political activity, the crucial requirement for breaking the stranglehold the wealthiest 1% have on our legislators was pointed out in SCFS's "Economic Conversion and Jobs". Thus all members were sent initiative petitions and apparently our support plus that from all "the usual organizations" obtained 706,000 signatures.

It is important to point out that a number of SCFS Executive Board members are very unhappy with this initiative, believing that it is much too weak. Concluding rationale was that this effort will hopefully be a beginning, so groundwork will be laid for a more effective initiative in the not-to-distant future.

As the funding solicitation letter for this Political Reform Initiative said. "It's time to take California elections off the special interest auction block and give them back to the voters."

Transportation

This three person group has been slow in compiling data and in deciding exactly what the most fruitful course of action will be. Readers may find it interesting to know that a generalized final Los Angeles area transportation system, including financing, has already been determined by this SCFS task group. Emphasis is on what a "best" system should be some fifty or sixty years hence. Once that is determined, a best path from "here to there" can be specified. The essential error of all present L.A. transportation planning is that everything is oriented toward modifying present systems without determining the far future goals first. This has resulted in plans for a hodge-podge of expanded bus and rail facilities which do not necessarily fit together or dovetail into a specific future system. One of the major revelations of the Wizard Show on MTA (Metropolitan Transportation Authority) operations was the lack of any long range plans. They do not even have a committee addressing this crucial aspect. Needless to say, MTA as a group appears to have no inclination to work with SCFS to develop substantial long range plans.

"Economic Conversion and Jobs"

As readers are aware from past issues of the Forum, this paper was published in slightly modified form and minus figures in the December, 1994, issue of Monthly Review. Since that time, much effort has been expended trying to influence various legislators and lobbying groups to at least pursue Economic Conversion which is a very realistic and practical program

SCFS has tried to interest such people as Jane Harmon, Ron Dellums, Barbara Boxer, and Bernie Sanders. However, none have responded after being approached several times. Needless to say, Center for Economic Conversion (which our own Ted Williams is an advisor to) refused to even entertain an SCFS article in their newsletter. In other words, Ted's ideas on how to convert from military to nonmilitary production are not acceptable to the very organization he is an advisor to.

Announcement

SCFS regrets to announce the passing away of James Garvey, a founding member of the organization. Dr. Garvey was active for some years and will be fondly remembered by the "old timers".

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EXPERIMENTAL BREEDER REACTOR IN IDAHO: AN ONGOING CHRONICLE

James C. Warf
February 1996

THE SETTING. — The Department of Energy had been operating an experimental breeder reactor for about 30 years in southeast Idaho, and approximately 43 metric tonnes of spent fuel has accumulated. The Laboratory has developed a process for treating this waste to separate out pure uranium with a high uranium-235 content and to convert everything else into a glass for geological disposal. In order to qualify for permission to perform these operations, a legal requirement for public hearings on a proposed environmental assessment had to be met. The Committee to Bridge the Gap, headquartered here in Los Angeles, was invited to send delegates to Idaho Falls for the hearings on February 21. The Southern California Federation of Scientists has long cooperated with the CBG. Four of us flew to Salt Lake City and drove a rented car to Idaho Falls. These were: Dan Hirsch, President of the CBG, Christine Owen and Bennett Ramberg of the CBG board, and myself.

THE MEETINGS IN IDAHO FALLS. — After spending a morning in a DOE library at Idaho State University, we attended the first session of the hearings that afternoon. More than 100 people attended. The chair gave a lecture on the proposed technology (described below), and a panel of five DOE officials made comments and answered questions. There was a series of about 20 speakers, each allotted a short time. There were both organizations and unassociated individuals, and while their views ranged the spectra of rationality and relevance, most seemed to make a sincere effort to understand the processes and the reasons they were developed. Two or three speakers displayed in-depth ignorance. I would say the majority of those present favored proceeding with the work. Dan gave a focused critique, outlining criticisms of the pyroprocessing procedures. Bennett developed the objection that once perfected, the process enables smaller countries to use it to separate bomb-grade plutonium. I pre-

sented an alternative technology which avoids all separations, and thus presents no possibility of plutonium separation. There was an exhibit of stainless steel assembly parts; tubing for uranium fuel, hexagonal jackets for clusters of fuel tubes, etc., all heavy and expensive.

That evening's session was attended by still more people. This time all four of us spoke, Dan, Bennett, and Christine expanding on the dangers of the nuclear proliferation theme and related topics. I spoke on other breeder reactors in the world, mentioning for example the Hanford Fast Flux Test Facility, the Russian and Kazakh breeders, and those in France and England, shut down for the time being. Also, I described the Japanese breeder Monju, on the west coast of Honshu, a new, expensive reactor. The name Monju derives from Buddhist mythology; a Bodhisattva sits serenely on a lion's back and controls raw nature through pure wisdom. Whether this choice of names is appropriate remains to be seen.

In response to a question, one of the DOE panel members, obviously a competent and dedicated engineer, answered in a way which left the impression that the electrometallurgical procedure developed (see below) could not be used to separate plutonium from spent fuel. Dan challenged him on this, and the three of us conferred in the hall afterwards. He agreed to give a clarification of this important point, and did so.

NUCLEAR REACTORS. — Speaking in a bare-bones style, commercial nuclear reactors are filled with zirconium tubes packed with uranium dioxide fuel pellets and the assembly is bathed in circulating water. The fuel is enriched in uranium-235 up to 3% or 4%. The natural content is only 0.7%; the remaining uranium is isotope 238. In a self-sustaining chain reaction, the uranium-235 undergoes fission by neutrons into fission products (radioactive isotopes of ordinary elements), accompanied by surplus neutrons, gamma rays, and lots of thermal energy. The water boils, and the resulting steam turns turbines, generating electricity. The neutrons born of fission are highly energetic ("fast")

and the water also serves to slow them down (“moderation”). The excess neutrons are taken up by the uranium-238, forming U-239, which decays quickly in two steps to plutonium-239.

Elements whose nuclei easily undergo fission by slow neutrons are said to be *fissile*. The only one which occurs in Nature is uranium-235. Two others, which are synthetic, are uranium-233 and plutonium-239. These nuclei are readily fissioned by either fast or slow neutrons. Nuclear bombs are made from them. Elements which are not fissile but which can be transformed into fissile material are said to be *fertile*. An example is the uranium-238 mentioned above, which is converted into plutonium-239. Another example is thorium-232, and it is even more abundant than uranium. It can be converted into uranium-233. Nuclei of fertile elements are fissioned only by fast neutrons.

Commercial reactors are able to generate only about 1% of the energy actually present in the fuel. When it was found that 100 nuclei of uranium-235, on fission using one neutron each, yield 243 neutrons, it became clear that this profit of 143 neutrons could be used to drive a nuclear reactor or to make a bomb possible. In the case of plutonium-239, 100 nuclei on fission liberate even more neutrons, namely 289, and hence it too can be used as reactor fuel or to make bombs. Moreover, early on physicists recognized that these properties could make it possible to convert uranium-238 into plutonium-239 to the extent that more plutonium is formed from abundant uranium-238 than the amount of uranium-235 consumed. That is, a reactor based on this principle could *breed* fissile material from fertile material in quantity, and in principle as much as 75% of the total energy locked up in heavy nuclei could be utilized. The great advantage of reactors for breeding fissile materials from fertile materials was too attractive to pass up.

BREEDER REACTORS. — The first breeder reactor was built in Los Alamos in 1946. It was a cute little thing, the core being only six inches high and the same distance across. The reactor was affectionately nicknamed Clementine, an appellation derived from the familiar song. Not only was the reactor in a canyon, but also a wartime code word for element 94 (plutonium) was simply 49, the dig-

its being reversed for greater security. Sometimes the Los Alamos scientists were called the forty-niners. Anyway, Clementine was cooled with mercury, which hardly absorbs fast neutrons. The fast neutrons from fission were not moderated, and the reactor ran on fast neutrons only, hence the term fast reactors.

During WW II the first reactor, built at the University of Chicago, was later moved outside Chicago to a site called Argonne. A few years after the war, a site for what is now called the Idaho National Engineering Laboratory was taken over from a naval gunnery range. Here the newer military reactors were designed; construction was at Hanford, Washington, and at the Savannah River Plant, Aiken, South Carolina. Another laboratory was built in the same territory in Idaho and it was named Argonne-West. A breeder was constructed there in 1951, and it was labeled Experimental Breeder Reactor I. This one used an alloy of sodium and potassium metals for cooling. It was the first nuclear reactor to generate electricity, although the rate was low, only 100 watts.

Experimental Breeder Reactor II (EBR II), costing more than \$32 million, started up in 1965 and ran for 30 years. It produced about one megawatt of heat and 300 kilowatts of electricity, but was capable of producing much more. The fuel consists of uranium rods or “elements” 5 millimeters in diameter (like a pencil) and 13 inches long. This fuel is 67% uranium-235 when fresh and approximately 65% on removal; the difference becomes fission products. It also contains 10% zirconium. Each fuel element is inserted into a thin-walled stainless steel tube and a small amount of sodium metal is also put in (see sketch). The tube is welded shut at the top to form a unit 29 inches long. The purpose of the sodium is to function as a heat-transfer agent. As more and more of the uranium undergoes fission, it develops fissures and the sodium enters the voids. It extracts an important fission product, cesium-137, and hence becomes intensely radioactive. The void above the uranium collects fission gases, mainly krypton-85. Clusters of the pins inside hexagonal stainless steel jackets 92 inches long are assembled honeycomblike; each unit has about 10 pounds of uranium. All together, the core contains

about 680 pounds of uranium fuel, and this part is called the driver.

Outside the driver is a similar collection of stainless steel hexagonal bars, and outside that is a large amount of depleted uranium, that is, uranium stripped of most of its U-235, and there are vast stores of this material. This uranium blankets the core and stainless steel parts, so to speak, and is thus rather unimaginatively called the blanket. Its purpose is to stop or reflect the fast neutrons streaming out of the core (the steel does not moderate them). The blanket, made of uranium-238, undergoes fission in part and absorbs the excess neutrons to form plutonium-239, that is, the process is breeding. EBR II is cooled by liquid sodium, no less than 66,000 gallons of it. There is a primary cooling system whose sodium entering the core is subject to intense gamma ray and neutron bombardment. It transfers its heat to a secondary system whose sodium boils water to generate steam and the electric power. The blanket too must be cooled by liquid sodium. The reactor and first heat exchanger are immersed in the huge tank of liquid sodium. Control is achieved by lowering or raising rods containing boron carbide. The steam produced in the secondary heat exchanger is at 455°C (851°F). In an experiment the reactor was going full blast and the sodium pumps were deliberately stopped. The reactor has a negative temperature coefficient of reactivity, and soon shut itself off. This is because the reactor is barely critical, and expansion of the metallic uranium fuel lowers the neutron flux, the opposite of the effect of compression on implosion. There is another fast reactor installation in the U.S., namely the Enrico Fermi Atomic Power Plant, located in Michigan.

ELECTROMETALLURGICAL TECHNOLOGY. — A technique has been developed at Argonne-West to remove the unchanged uranium from the spent fuel driver assembly and blanket and to collect the fission products and transuranic elements (neptunium, plutonium, americium, and curium) into a mineral which is then vitrified. The hexagonal steel assemblies of pins, now deadly radioactive, are pulled from the top of the core into lead shielding weighing 30 tons. After aging to allow the short-lived radionuclides to decay, the spent

fuel is taken through a lock into a round chamber inerted with argon. Operators outside the argon cell, as it is called, look through five-foot lead-glass windows and manipulate the apparatus inside. No one ever enters the argon cell. The pins are removed from their steel casing and are chopped into small lengths. The pieces are dumped into a steel basket and lowered into the electrorefiner. This consists of a steel container holding a molten mixture of potassium chloride and lithium chloride; its temperature is 500°C (932°F). There is also a steel electrode in the molten salt. A direct current is passed through the molten salt, causing the spent fuel to dissolve from the basket (positive) and electroplate out onto the other steel electrode (negative). The fission products and transuranic metals stay in the molten salt, which is then pumped through a bed of an aluminosilicate called zeolite. There are several kinds of zeolite, some occurring as a mineral and others made synthetically. They have open structures with channels and contain light metals such as sodium, calcium or potassium. Light metals are readily exchanged for heavier metal ions, as in a process employed in water softeners. Therefore the molten potassium/lithium chloride is pumped through dry zeolite in the potassium form, when the fission products and transuranic metals are adsorbed out by displacing the potassium ions. After draining, the zeolite is mixed with the components of glass, fused, and is ready for a geological repository.

VISITING THE EBR II FACILITY. — At the end of the evening session, snow was falling as we returned to our motel. The next day we drove through pleasant farmlands covered with pristine snow. It was about 30 miles to the site of Argonne-West and the EBR II. We were escorted through all the important buildings and we asked many questions. I was given a permit for my camera. The reactor itself is not visible since it is submerged in a tank of liquid sodium, but all the auxiliary equipment could be inspected. The reactor building is adjacent to another one called the Fuel Conditioning Facility, which had massive steel doors on the ends of air locks. The heavily-shielded spent fuel is brought in through a sort of lock. It is transferred into the circular argon-filled cell for processing. Operators conduct the operations looking through

the thick lead-glass windows. The electrorefining procedure described above is carried out. The uranium, containing about 65% U-235, is melted down with depleted uranium (only 0.3% U-235) to produce metal with less than 20% U-235. This metal and the waste are being stored until final decisions are made about their disposal. EBR II is capable of using as fuel uranium-238 alloyed with plutonium from dismantled nuclear bombs and thus contribute to the permanent destruction of this dreadful metal.

During our tour of the facility, we had to have full-body radioactivity measurements on entering and again on leaving. My Geiger counter showed normal background readings in all buildings except one, and even here the measurement was only about 50% above background. Uranium-bearing fuel for nuclear reactors undergoes processing in its manufacture, and the term *reprocessing* is used to treat the spent fuel to separate out bomb-grade plutonium. President Carter ordered commercial reprocessing halted in the late 1970s, and no President since has changed that decision. The officials at EBR II insist that the electrorefining procedure is not, definitely not, reprocessing. Interpreted from the standpoint of intent to separate plutonium, they are correct, but with some modifications, plutonium could be produced, in which case it would definitely be reprocessing.

CRITIQUE. — While not immune from possible dangers, the EBR II struck me as a distinct advance in reactor technology in some ways. The risk of a Chernobyl-like disaster is minuscule. The problem of final disposal of the radioactive waste is not yet fully addressed. Theft of weapons-grade uranium-235 from the argon cell is virtually impossible, but shipping the material cross country to the site always poses some hazard of theft. The labor costs of the electrorefining step might be unacceptably high, but further development could possibly solve this aspect. Probably the greatest hazard arises from spreading sophisticated technologies around the world, technologies which make reprocessing spent fuel easier and possible in facilities small enough to conceal underground.

All in all, the four of us agreed that the trip to Idaho was eminently successful.

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